

# Registration of 'Guymon' Wheat

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## ABSTRACT

'Guymon' (Reg. No. CV-1018, PI 643133) is a hard white (HW) winter wheat (*Triticum aestivum* L.) cultivar developed and released cooperatively by the Oklahoma Agric. Exp. Stn. (AES) and the USDA-ARS in 2005. It is recommended for areas of the southern High Plains centered by the city serving as its namesake, Guymon, OK.

'Guymon' is an  $F_2$ -derived line selected from the cross, OK95G701/WI89-163W, performed in 1995. OK95G701 was eventually released by the Oklahoma AES and the USDA-ARS as 'Intrada' (Carver et al., 2003), whereas WI89-163W was subsequently named and released by AgriPro-Coker as 'Platte' (R.G. Sears, personal communication, 2007). Single heads were collected from a  $F_2$  bulk population grown at Stillwater, OK in 1997. In the following year, selection was imposed in Stillwater, OK on 96  $F_{2,3}$  head rows of this population based on late-spring freeze tolerance, stem extension, spike density and size, kernel size, uniformity of phenotype at harvest maturity, and consistent kernel color. An unusually high proportion of head rows (19%) was selected from this population due to desirable kernel color, color uniformity, and within-line plant uniformity. Fourteen head rows were advanced for progeny evaluation. The head-row progeny was evaluated in 1999 at Stillwater and Lahoma, OK and selected on the basis of forage accumulation, fall vegetative growth habit, simulated-grazing tolerance, spring

green-up, heading date, test weight, grain yield, wheat protein content, kernel hardness, and kernel size. Subsequent generations were advanced by bulk-selfing in the field. Minimal roguing of slightly taller variants was performed each year until 2004 despite this line being  $F_2$ -derived. With an initial frequency of 1.5% red kernels, seed from the 2003 harvest were passed through a single-kernel sorter to reduce the frequency of red kernels to < 0.3% (Engineering Research Unit, USDA-ARS-GMPRC, Manhattan, KS). From a final breeder-seed increase in 2004, we detected 0.0 to 0.2% red kernels based on the NaOH-bleach test (Ram et al., 2002) of multiple samples. As of the 2006–2007 crop year, Guymon is a  $F_2$ -derived line in the  $F_{12}$  generation.

Using OK00618W as the experimental designation, Guymon appeared in replicated breeder nurseries conducted throughout Oklahoma from 2000 through 2004, in the 2003 USDA-ARS Regional Germplasm Observation Nursery (entry 161), in the Southern Regional Performance Nursery (SRPN) in 2004 (entry 18) and 2005 (entry 37), and in the 2004 Hard Winter Wheat Milling and Baking Evaluation Program conducted by the Wheat Quality Council. It was also included in the Oklahoma State University Wheat Variety Trials (OWVT) beginning in 2004.

Guymon is a moderately tall, semidwarf wheat, with relatively early arrival to first-hollow-stem (FHS) stage but moderately late heading date. Averaged across two years (2004 and 2005), it reached the FHS stage in central Oklahoma 1 d later than the early FHS-stage cultivars, Jagger (Sears et al., 1997) and Intrada, but 16 d earlier than the late FHS-stage cultivar, 'Trego' (Martin et al., 2001). Heading date for Guymon is 2 d later than both Intrada and Trego, and 5 d later than Jagger. Similar to Intrada and Jagger, Guymon shows rapid stand establishment with low sensitivity to high temperature (35°C ambient temperature) during germination. Its semi-erect to erect vegetative growth habit (similar to Intrada, but appears slightly less aggressive in fall forage accumulation) is a distinguishing characteristic versus the prostrate growth habit and conservative growth pattern of Trego. Plant height of Guymon in Oklahoma is 80 cm, or about 2 cm taller than Intrada and Trego. Based only on environments with moderate to severe lodging, Guymon scored a mean rating of 2.4 on a scale of 1 (tolerant) to 5 (susceptible), compared with 2.7 for Intrada and 3.3 for Jagger. Guymon is susceptible to pre-harvest

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**Abbreviations:** FHS, first-hollow-stem; GBSS, granule-bound starch synthase; HWWQL, Hard Winter Wheat Quality Laboratory; OWVT, Oklahoma State University Wheat Variety Trials; PPO, polyphenol oxidase; SKCS, single-kernel characterization system.

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sprouting (PHS) based on germination tests of threshed seed from spikes collected at physiological maturity in the field.

Based on field observations in Oklahoma, Guymon is resistant to *Wheat soilborne mosaic virus* and *Wheat spindle streak mosaic virus*, but moderately susceptible to *Barley yellow dwarf virus*. Based on field observations of adult plants across Oklahoma in 2007, it showed a moderately susceptible reaction to leaf rust, caused by *Puccinia triticina* Eriks. Before 2005, Guymon appeared to be moderately resistant to stripe rust, caused by *P. striiformis* Westendorp. f. sp. *tritici*. During the stripe rust epidemic in 2005, Guymon scored 2.8 across four Oklahoma sites on a scale of 0 to 4; the susceptible check, 'Ok102', also scored 2.8 and Intrada scored 2.3. Based on *P. striiformis* races currently present in Oklahoma, Guymon is considered susceptible to stripe rust in the seedling and adult-plant stages. It has shown a resistant reaction to wheat stem rust, caused by *P. graminis* f. sp. *tritici*, based on field reactions in 2005 at St. Paul, MN (composite of races MCCF, QFCS, QTHJ, RCRS, RKQQ, TPMK, TTTT) and at Njoro, Kenya (race TTKS) (data provided by Y. Jin, USDA-ARS, St. Paul, MN).

Based on greenhouse observations, Guymon is moderately susceptible to tan spot [*Pyrenophora tritici-repentis* (Died.) Drechs.] and to powdery mildew (*Blumeria graminis* f. sp. *tritici*) but resistant to septoria leaf blotch (*Septoria tritici* Roberge in Desmaz.). It is susceptible to biotypes C and E of the greenbug (*Schizaphis graminum* Rondani) and to Hessian fly (*Mayetiola destructor*).

Flag leaves of Guymon at the boot stage are green, recurved, twisted, and non-waxy. Spikes are white-chaffed, awned, oblong, lax, and recurved at harvest-maturity. Kernels are white, hard-textured, elliptical, and they have a midwide, shallow crease, angular cheeks, and large germ.

Across 30 grain-only sites of the 2004 SRPN, Guymon ranked 28th among 50 entries, with a mean yield of 3890 kg ha<sup>-1</sup> compared with the long-term checks, 'TAM 107' at 3690 kg ha<sup>-1</sup> and Trego at 3940 kg ha<sup>-1</sup> (LSD = 250 kg ha<sup>-1</sup>, *P* = 0.05). In the 2005 SRPN across 32 grain-only sites, Guymon ranked 28th among 48 entries, with a mean yield of 3540 kg ha<sup>-1</sup> compared with TAM 107 at 3050 kg ha<sup>-1</sup> and Trego at 3280 kg ha<sup>-1</sup> (LSD = 270 kg ha<sup>-1</sup>, *P* = 0.05). A primary motivation for releasing Guymon was to improve on the grain yield of Intrada with minimal decline in grain volume weight. This was corroborated in the OWVT in 2004, where mean yields across three north-west Oklahoma trials for Guymon and Intrada were 3560 and 2920 kg ha<sup>-1</sup>, respectively (LSD = 270 kg ha<sup>-1</sup>, *P* < 0.05) and mean grain volume weight for Guymon and Intrada were 80.9 and 80.6 kg hL<sup>-1</sup>, respectively (LSD = 2.3 kg hL<sup>-1</sup>, *P* > 0.05). During the stripe-rust epidemic of 2005, however, grain yield of Guymon and Intrada were similar at 3060 and 3080 kg ha<sup>-1</sup>, respectively. Mean grain volume weight for Guymon and Intrada were 76.9 and 78.3 kg hL<sup>-1</sup>, respectively (LSD = 2.4 kg hL<sup>-1</sup>, *P* > 0.05). Comparisons in 2006 were nullified by losses due to hail and severe drought stress.

Guymon's high grain volume weight patterns are accompanied by small kernel size. Across 15 site-years in Oklahoma from 2002 to 2004, Guymon averaged 58% large-kernel fraction using the Tyler Ro-tap sieve shaker (W.S. Tyler Co., Mentor, OH), 28.1 mg kernel weight based on the single-kernel characterization system (SKCS), and 2.26 mm SKCS-kernel diameter.

Guymon appears better suited for pan bread production than Asian fresh noodle products based on evaluation of multi-locat-

ion composite grain samples from two crop seasons (2004 and 2005) by the USDA-ARS Hard Winter Wheat Quality Laboratory (HWWQL) in Manhattan, KS. Guymon averaged 644 g kg<sup>-1</sup> in flour yield with a flour ash content of 31 g kg<sup>-1</sup>. The check cultivar OK Bullet, noted for exceptional milling and baking quality (Carver et al., 2006), produced values of 674 g kg<sup>-1</sup> and 31 g kg<sup>-1</sup> for flour yield and flour ash, respectively. Wheat and flour protein (140 g kg<sup>-1</sup> moisture basis) averaged 130 g kg<sup>-1</sup> and 116 g kg<sup>-1</sup> for Guymon, respectively, compared with 131 g kg<sup>-1</sup> and 117 g kg<sup>-1</sup> for OK Bullet. Straight-dough baking quality of Guymon is considered above-average, with 616 g kg<sup>-1</sup> bake absorption, mixing tolerance score of 3.0 on a 0 (poor)-to-6 (good) scale, 4.2 min bake mixing time, 925 cc loaf volume, 73 loaf-volume regression score, and 4.5 for crumb-grain score on a 0 (poor)-to-6 (good) scale. Corresponding values for OK Bullet were 632 g kg<sup>-1</sup> bake absorption, 4.0 mixing tolerance score, 5.2 min bake mixing time, 857 cc loaf volume, 64 loaf-volume regression score, and 4.0 crumb-grain score.

The American Assoc. of Cereal Chemists (AACC) method 22-85 was modified by the HWWQL using ground wheat rather than whole-kernel samples to measure polyphenol oxidase (PPO) activity. Guymon's PPO score averaged 0.474 absorbance units, which may restrict its use in some Asian fresh noodle products such as white salted noodles. Procedures described by Guo et al. (2003) were adopted by the HWWQL to determine alkaline noodle color stability. Guymon showed a mean initial alkaline noodle brightness of 81.9 CIE L\* units and a 24-hr decline in brightness of 8.35 CIE L\* units. High-molecular-weight glutenin subunits which are present in Guymon at the *Glu-A1*, *Glu-B1*, and *Glu-D1* loci are, respectively, 2\*, 20x+20y, and 5+10 (Shan et al., 2007). Guymon is void of any wheat-rye translocation, and it contains no *wx-B1* null allele at the granule-bound starch synthase (GBSS) locus based on the GBSS-gene specific primer no. 4 designed by McLaughlan et al. (2001).

Small quantities of seed may be obtained from the corresponding author for at least five years for research purposes, including use in development and commercialization of new cultivars. Seed has been deposited in the National Plant Germplasm System. Authorized seed classes are Breeder, Foundation, Registered, and Certified. The Oklahoma Agricultural Experiment Station will maintain Breeder seed. Application for U.S. Plant Variety Protection (Title V) has been filed (no. 200600257).

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